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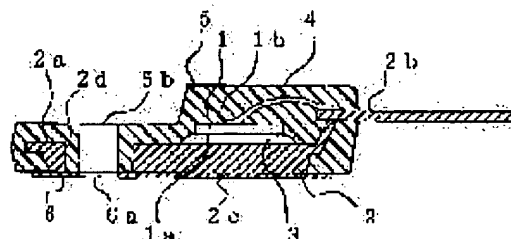
(54) RESIN-SEALED POWER SEMICONDUCTOR DEVICE AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a resin-sealed power semiconductor device which is excellent in thermal conductivity, electric insulating properties, and reliability and inexpensive, and a method of manufacturing the same.

SOLUTION: A semiconductor pellet 1 is fixed on the one main surface of a lead frame 2, a heat dissipating surface 2c is formed on the other main surface, the semiconductor pellet 1 is sealed up with resin so as to expose the heat dissipating surface 2c, and a resin package 5 is formed by making the exposed heat dissipating surface 2c nearly flush with the lower surface

of sealing resin which surrounds the heat dissipating surface 2c, and a resin film 6 which is high in thermal conductivity and electric insulation properties is bonded to the heat dissipating surface 2c and the lower surface of the sealing resin, by which the cost of sealing resin can be lessened, the maintenance cost of a molding die can be reduced, and transfer molding conditions can be easily controlled.



- | | |
|-------------|----------------|
| 1 : 半導体ペレット | 3 : 半田 |
| 2 : リードフレーム | 4 : 金属グランド |
| 2a : 放熱台板 | 5 : 樹脂パッケージ |
| 2b : 電極リード | 6 : 高熱伝導絶縁フィルム |
| 2c : 放熱面 | |

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DETAILED DESCRIPTION

[Detailed description]

[0001]

[The technical field to which invention belongs] Especially this invention relates to the electric insulation of the heat sinking plane formed in the thermolysis base plate of a leadframe in a resin package about the semiconductor device for plastic-molded-type power, and its manufacture technique.

[0002]

[Prior art] Drawing 6 is the cross section showing the conventional semiconductor device for plastic-molded-type power. In drawing, 1 is a semiconductor pellet as a semiconductor device, 2 is a leadframe, it consists of thermolysis base plate 2a and electrode lead 2b, the semiconductor pellet 1 is mounted on one principal plane of thermolysis base plate 2a, and heat sinking plane 2c which radiates heat in generation of heat of the semiconductor pellet 1 to a thermolysis sink (not shown) to the principal plane of another side is formed.

[0003] And rear-face electrode 1a of the semiconductor pellet 1 fixes with the solder 3 as junction material in one principal plane of thermolysis base plate 2a, between surface electrode 1b of the semiconductor pellet 1 and electrode lead 2b is wired with the metal wire 4 (wirebonding), a resin seal is carried out so that the whole may be covered, and the resin package 5 as resin-seal section is formed. In addition, the breakthrough by which 5a attaches heat sinking plane 2c in the above-mentioned thermolysis sink with which a wrap resin layer and 5b were formed in the resin package 5 and which ****s (not shown), and 2d are the breakthroughs of the diameter of the macrostomia more in the shape of breakthrough 5b and a concentric circle formed in thermolysis base plate 2a, and an opening (breakthrough 5b and 2d of breakthroughs) is full of a resin, and is carrying out the electric insulation of between a leadframe 2

[0004] The characteristic point of the above-mentioned semiconductor device for plastic-molded-type power is a point of reconciling the function which carries out heat transfer of the heat sinking plane 2c of thermolysis base plate 2a and thermolysis base plate 2a for generation of heat of the semiconductor pellet 1 to the above-mentioned thermolysis sink through wrap resin layer 5a, and the function which carries out the electric insulation of between thermolysis base plate 2a and the above-mentioned thermolysis sink by resin layer 5a.

[0005] Since this heat transfer and electric insulation are reconciled (i.e., since it has the electric insulation which was excellent with high temperature conductivity), the thinning of wrap resin layer 5a is attained for heat sinking plane 2c which high-fills up a **** resin with fillers (not shown), such as a crystalline silica which whose impurity concentration was low and was excellent in the electric insulation while thermal conductivity was high, and was excellent in economical efficiency, and is located in the rear-face side of the semiconductor pellet 1 loading side of thermolysis base plate 2a. Although the thickness of this resin layer 5a has a desirable thing thin as much as possible when a heat-conducting characteristic is thought as important, while electric insulations, such as withstand-voltage nature, are secured, the thickness of 400 micrometers - 600 micrometers is usually chosen for the reservation of a moldability in the transfer-molding process for formation of the resin package 5.

[0006]

[Object of the Invention] the case where wear of the expensive metal mold (not shown) for resin seals was remarkable, and a general-purpose resin is used since the conventional semiconductor device for plastic-molded-type power is constituted as mentioned above (i.e., since the **** resin of high temperature conductivity high-filled up with the fillers (not shown) of a high degree of hardness, such as a crystalline silica, was used) -- comparing -- the above -- there was a trouble where the maintenance cost of metal mold became a large sum

[0007] Moreover, although a management of the process condition for not making resin layer 5a generate a pinhole and a void becomes indispensable in a resin-seal process in order to fabricate resin layer 5a of thin meat For the resin which the **** resin of the above-mentioned high temperature conductivity made high-fill up with the above-mentioned filler, as compared with the general-purpose resin, the resin flowability was inferior, that it is few and generally the margin at the time of molding is expensive, and there was a trouble of a resin-seal cost rising.

[0008] As an improvement means of the above-mentioned technical problem, in for example, a Provisional-Publication-No. 135753 [59 to] official report Although an electric-insulation layer is given to the heat sinking plane of a leadframe in advance, a semiconductor pellet is mounted after that and the semiconductor device which carried out the resin seal of the leadframe to one by the electric-insulation component is indicated except for the front-face top of the above-mentioned electric-insulation layer When the epoxy resin used abundantly by the ground economical as the above-mentioned electric-insulation layer was used, the new trouble where the process temperature in the case of using elevated-temperature solder (300 degrees C - 400 degrees C) could not usually be borne at the process which mounts the semiconductor pellet in a back process arose.

[0009] Moreover, although the semiconductor device which -ed **ed the coating layer which becomes the rear face of the thermolysis base plate which forms the resin-seal section in a Provisional-Publication-No. 218759 [59 to] official report so that the front-face top of another side by which the semiconductor pellet of a thermolysis base plate is not ****ed may be exposed, and is exposed to it from this resin-seal section, for example from a resin is indicated The above-mentioned coating layer is 5 micrometers - about 15 micrometers in thickness, cannot secure the electric insulation demanded for the purpose of an improvement of the corrosion resistance of a heat sink, crack-proof nature, etc., and does not serve as the improvement means of the above-mentioned technical problem.

[0010] this invention is made in order to cancel the above troubles, it makes unnecessary a **** resin expensive to formation of the resin package 5 while it is excellent in thermal conductivity and an electric insulation, and it is cheap and it aims at offering the highly reliable semiconductor device for plastic-molded-type power and its highly reliable manufacture technique.

[0011]

[The means for solving a technical problem] The semiconductor device for plastic-molded-type power concerning the 1st invention In the semiconductor device for plastic-molded-type power equipped with the resin-seal section which carries out the resin seal of the above-mentioned semiconductor device so that the principal plane of another side of the thermolysis base plate which the semiconductor device fixed, and this thermolysis base plate may be exposed to one principal plane While the heat sinking plane side front face of the above-mentioned resin-seal section which surrounds the circumference of the principal plane of above-mentioned another side is formed in the principal plane and abbreviation same flat surface of above-mentioned another side, the sheet made from a resin is joined to the above-mentioned heat sinking plane side front face including the principal plane of above-mentioned another side.

[0012] Moreover, the semiconductor device for plastic-molded-type power concerning the 2nd invention joins the sheet made from a resin to all the front faces of a heat sinking plane side front face in the semiconductor device for plastic-molded-type power concerning the 1st invention.

[0013] Moreover, the semiconductor device for plastic-molded-type power concerning the 3rd invention constitutes the sheet made from a resin from a material of the resin-seal section by the material of high temperature conductivity in the semiconductor device for plastic-molded-type power concerning the 1st

invention or the 2nd invention.

[0014] Moreover, before the semiconductor device for plastic-molded-type power concerning the 4th invention consisting of thermosetting resin with which the sheet made from a resin filled up the filler of high temperature conductivity in the semiconductor device for plastic-molded-type power concerning the 1st invention or the 3rd invention and joining to the above-mentioned heat sinking plane side front face, it is in the semi-hardening status.

[0015] Moreover, the manufacture technique of the semiconductor device for plastic-molded-type power concerning the 5th invention While a resin seal is carried out and the resin-seal section is formed so that the principal plane of the process which fixes a semiconductor device, and another side of the above-mentioned thermolysis base plate may be exposed to one principal plane of a thermolysis base plate, and the circumference may be surrounded and the above-mentioned semiconductor device may be covered It is the manufacture technique of having the process which forms in the principal plane and abbreviation same flat surface of above-mentioned another side the heat sinking plane side front face which surrounded the circumference of the principal plane of above-mentioned another side in this resin-seal section in case of formation of this resin-seal section, and the process which joins the above-mentioned sheet made from a resin to the above-mentioned heat sinking plane side front face including the principal plane of above-mentioned another side.

[0016] Moreover, the manufacture technique of the semiconductor device for plastic-molded-type power concerning the 6th invention The process which fixes a semiconductor device in one principal plane of two or more above-mentioned thermolysis base plates in the leadframe with which two or more thermolysis base plates which make the principal plane of another side a heat sinking plane are connected in parallel by the tie rod, While a resin seal is carried out and batch formation of two or more resin-seal sections is carried out so that the principal plane of above-mentioned another side may be exposed, and the circumference may be surrounded and the above-mentioned semiconductor device may be covered The process which forms in the principal plane and abbreviation same flat surface of above-mentioned another side the heat sinking plane side front face which surrounds the circumference of the principal plane of above-mentioned another side in two or more of these resin-seal sections in case of batch formation of two or more of these resin-seal sections, While the process which carries out the batch junction of the sheet made from a resin of the shape of an above-mentioned strip of paper, and the above-mentioned tie rod are cut on the above-mentioned heat sinking plane side front face containing the principal plane of above-mentioned another side in two or more above-mentioned resin-seal sections and two or more above-mentioned resin-seal sections are separately separated from the above-mentioned leadframe It is the manufacture technique of having the process separated except for a part for the joint of the above-mentioned sheet made from a resin joined to two or more of these resin-seal sections.

[0017]

[Gestalt of implementation of invention] gestalt 1. of enforcement -- drawing 1 or drawing 4 explains the gestalt of implementation of this invention In drawing, drawing 1 is the cross section of the semiconductor device for plastic-molded-type power as gestalt 1 of enforcement, 1 is a semiconductor pellet as a semiconductor device, 2 is a leadframe, it consists of thermolysis base plate 2a and electrode lead 2b, the semiconductor pellet 1 is mounted on one principal plane of thermolysis base plate 2a, and heat sinking plane 2c which radiates heat to a thermolysis sink (not shown) in generation of heat of the semiconductor pellet 1 to the principal plane of another side is formed.

[0018] Drawing 2 is the plan of the leadframe after wirebonding in the semiconductor device for plastic-molded-type power shown in drawing 1 , and two or more two or more semiconductor devices for plastic-molded-type power are simultaneously connected with the leadframe 2 in parallel by tie-rod 2e possible [formation] in the pattern of thermolysis base plate 2a of a part (it sets to drawing 2 and is four pieces), and electrode lead 2b. In addition, drawing 3 is the cross section of the resin package which shows the A-A cross section after the resin seal in drawing 2 , and as a leadframe 2 is shown in drawing 3 , the material from which thermolysis base plate 2a becomes heavy-gage to electrode lead 2b is used.

[0019] And a resin seal is carried out and the resin package 5 as resin-seal section is formed so that rear-face electrode 1a of the semiconductor pellet 1 fixes with the solder 3 as junction material in one

principal plane of thermolysis base plate 2a, and between surface electrode 1b of the semiconductor pellet 1 and electrode lead 2b may be wired with the metal wire 4 (wirebonding) and may cover the whole, however so that heat sinking plane 2c may be exposed. And while the heat sinking plane side front face of the resin which surrounds the circumference of heat sinking plane 2c in the resin package 5 is formed in heat sinking plane 2c and an abbreviation same flat surface, the high temperature duction resin film 6 as a sheet made from a resin is joined to the above-mentioned heat sinking plane side front face including heat sinking plane 2c.

[0020] In addition, 5b is a breakthrough which is attached in the above-mentioned thermolysis sink formed in the resin package 5 and which ****s (not shown), and breakthrough 6a of the diameter of the same is carrying out opening also to the high temperature duction resin film 6 at the shape of breakthrough 5b and a concentric circle. Moreover, 2d of the breakthroughs of the diameter of the macrostomia is carrying out opening also to thermolysis base plate 2a more by the shape of breakthrough 5b and a concentric circle, and an opening (breakthrough 5b and 2d of breakthroughs) is full of a resin, and is carrying out the electric insulation of between a leadframe 2 and the above-mentioned screw thread.

[0021] Moreover, the high temperature duction resin film 6 is a film made from the epoxy resin of the uniform thickness of about 200 micrometers of thicknesss. By carrying out heating hardening, after containing an alumina (not shown) 100% of purity, are supplied as a strip-of-paper-like film of the semi-hardening status and carrying out ***** adhesion as an inorganic filler of high temperature conductivity on heat sinking plane 2c and the above-mentioned heat sinking plane side front face While high temperature conductivity and the outstanding electric insulation are obtained, the thermal stress generated between thermolysis base plate 2a is borne, and it has powerful adhesive power, flexibility, etc. that adhesion should be held.

[0022] That is, the high temperature duction resin film 6 can carry out temporary adhesion at 70 degrees C while it has flexibility before a junction, and it is excellent in junction workability. And it has the fast curability which can be hardened less than [150 degree-Cx10 minute], and it has good golden striking omission nature, and is excellent in workability while after hardening is excellent in the adhesive power to copper and aluminum.

[0023] Next, drawing 2 or drawing 4 explains the manufacture technique of the semiconductor device for plastic-molded-type power shown in drawing 1 . First, it comes, whenever it is shown in drawing 2 , and the leadframe 2 with which the pattern of thermolysis base plate 2a [two or more (four pieces)] and electrode lead 2b is connected in parallel by tie-rod 2e is prepared.

[0024] Next, die bond of the semiconductor pellet 1 is mounted and carried out to one principal plane of thermolysis base plate 2a. That is, rear-face electrode 1a of the semiconductor pellet 1 fixes with the solder 3 as junction material in one principal plane of thermolysis base plate 2a. Then, between surface electrode 1b of the semiconductor pellet 1 and electrode lead 2b is wired with the metal wire 4 (wirebonding).

[0025] Next, in the resin-seal process by transfer molding, while heat sinking plane 2c which is a clamp face side to the above-mentioned thermolysis sink in a leadframe 2 is exposed, the circumference of heat sinking plane 2c is surrounded by the resin, and the loading side side of the semiconductor pellet 1 is *****ed by the resin. In this case, a resin seal is carried out so that the heat sinking plane side front face of the resin which surrounds the circumference of exposed heat sinking plane 2c and heat sinking plane 2c may succeed in an abbreviation same flat surface.

[0026] And the resin package 5 which the heat sinking plane (not shown) exposed to each pattern correspondence connected in parallel is formed in a leadframe 2, respectively. in addition, 5c -- the time of a resin seal -- metal mold -- the remains of a pin of the movable pin (not shown) for frame fixation which fixes the leadframe 2 with which it was loaded inside are shown

[0027] Next, it is batch ***** about the film made from the epoxy resin of a semi-hardening form of about 200 micrometers of the thicknesss which succeed in the high temperature duction resin film 6, the shape of i.e., a strip of paper, so that exposed heat sinking plane 2c in the resin package 5 currently formed in the leadframe 2 and the above-mentioned heat sinking plane side front face may be worn, as

shown in drawing 1 and drawing 4 . In addition, drawing 4 is a plan after joining a high temperature duction resin film, and drawing 1 shows the A-A cross section in drawing 4 .

[0028] In addition, although the width of face of the high temperature duction resin film 6 which makes the shape of a strip of paper is narrower than the width of face of the resin package 5, it is formed sufficiently more widely than the outcrop of heat sinking plane 2c in the domain which can secure many properties, such as an electric insulation containing withstand-voltage nature.

[0029] Next, ***** adhesion is carried out in the 70-degree C ambient atmosphere, succeedingly, it is left for 150 degree-Cx 10 minutes with a heating furnace, and both are firmly joined by carrying out heating hardening.

[0030] Although each resin package 5 is separated from a leadframe 2 by cutting tie-rod [leadframe / 2] 2e of the appropriate back, in this separation process, whenever it cuts the high temperature duction resin film 6 by which heating hardening was carried out along with the circumference and breakthrough 5b of the resin package 5 and it is shown in drawing 1 , it comes, and the semiconductor device for plastic-molded-type power is completed.

[0031] It succeeds in the configuration which joined the high temperature duction resin film 6 to heat sinking plane 2c and its circumference of the resin package 5. as mentioned above, as a high temperature duction resin film 6 The thing of the outstanding electric insulation which contains neither the foam nor an impurity while it is high temperature conductivity is obtained easily. And since it had flexibility by the shape of a strip of paper, there were very few possibilities of involving the foam etc. in a joint at the time of junction work, and while excelling in many properties, such as an electric insulation, as compared with what is depended on resin molding and coating of the conventional example, the semiconductor device for plastic-molded-type power which was extremely excellent in the heat-conduction property was obtained.

[0032] Moreover, since properties, such as the thermolysis and an electric insulation, are not dependent on the property of a **** resin depending on the property of the high temperature duction resin film 6 when it attaches in a thermolysis sink (not shown) and it presents practical use As a **** resin, economical efficiency and the ease of molding can be thought as important and a general-purpose resin can be used. Since the degree of hardness of the filler could be lowered, and the maintenance cost of metal mold could be cut down inevitably and the electric-insulation layer of thin meat was not formed in transfer molding while the price of the **** resin [itself] could be reduced as compared with the thing of the conventional example shown in drawing 6 , the management of a process condition became easy.

[0033] Furthermore, since the high temperature duction resin film 6 has flexibility before a junction, while it is excellent in junction workability, since after hardening is excellent in the adhesive power to copper and aluminum, and has good golden striking omission nature and is excellent in workability, it has little influence of the cost rise to the increase in the process which joins the high temperature duction resin film 6 after a resin-seal process.

[0034] gestalt 2. of enforcement -- drawing 5 explains the gestalt 2 of implementation of this invention Drawing 5 is the cross section of a resin package in the semiconductor device for plastic-molded-type power as gestalt 2 of enforcement. In the gestalt 1 of enforcement shown in drawing 1 , it succeeds in the same configuration except for the point which joined the high temperature duction resin film 6 to all the front faces of the heat sinking plane side front face in the resin package 5 which carries out the resin seal of the semiconductor pellet 1.

[0035] It joins so that all the front faces of two or more above-mentioned heat sinking plane side front faces where a shorter side stands the high temperature duction resin film 6 of the shape of a strip of paper of a heat sinking plane side front face and an abbreviation identity in the resin package 5 in a row by tie-rod 2e may be worn. Namely, after heating hardening, Double with the appearance of the resin package 5, cut the excessive fraction of the high temperature duction resin film 6, and it compares with the gestalt 1 of enforcement shown in drawing 1 . Since the width of face of the shorter side of the strip-of-paper-like high temperature duction resin film 6 and the width of face of the heat sinking plane side front face in the resin package 5 are abbreviation identities The positioning at the time of a junction becomes easy, ***** for a junction can be simplified, and since the touch area with a thermolysis sink

(not shown) increases while the manufacture is easy, it becomes that by which fixation by the screw thread (not shown) to this thermolysis sink was stabilized.

[0036] In addition, it is not necessary to limit to an epoxy resin, and in the gestalt 1 of enforcement, and the gestalt 2 of enforcement, although the thing using the epoxy resin as composition of the high temperature duction resin film 6 was illustrated, even if it selects thermosetting resin excellent in electric-insulation reliabilities, such as a polyimide, the heat-conduction property, etc., the same effect is acquired.

[0037] Moreover, although what was high-filled up with the alumina of 100% of purity as a filler which whose impurity concentration was low, was excellent in the electric insulation, and was excellent also in economical efficiency was illustrated while thermal conductivity was high since both the properties of the electric insulation containing the heat-conduction property and withstand-voltage nature of the high temperature duction resin film 6 were reconciled It is not necessary to limit the above-mentioned filler to the alumina of 100% of purity for example, and the same effect is acquired even if it is fillers, such as a crystalline silica, nitriding aluminum, a silicon nitride, and a boron nitride.

[0038] Furthermore, although the thickness of the high temperature duction resin film 6 was selected to 200 micrometers, it is not necessary to limit the thickness of the high temperature duction resin film 6 to 200 micrometers, and it can determine a thickness arbitrarily by trade-off of an electric insulation and thermal conductivity in 75 micrometers - 400 micrometers based on the specifications demanded, such as a withstand voltage.

[0039]

[Effect of the invention] Since this invention is constituted as mentioned above, it does so an effect which is shown below.

[0040] While the resin-seal section which carries out the resin seal of the above-mentioned semiconductor device where the principal plane of above-mentioned another side in the thermolysis base plate which fixes a semiconductor device in one principal plane, and makes the principal plane of another side a heat sinking plane is exposed is formed Since the heat sinking plane side front face of this resin-seal section was formed in the principal plane and abbreviation same flat surface of above-mentioned another side and the sheet made from a resin was joined to the above-mentioned heat sinking plane side front face including the principal plane of above-mentioned another side As a **** resin which forms the above-mentioned resin-seal section, high temperature conductivity and the outstanding electric insulation, Since withstand-voltage nature etc. is not necessarily needed but a general-purpose **** resin can be used, while the price of the **** resin [itself] can be reduced, the degree of hardness of the filler can be lowered. Since the maintenance cost of metal mold can be cut down inevitably and the electric-insulation layer of thin meat is not formed in transfer molding, a management of a process condition becomes easy. It is effective in the semiconductor device for plastic-molded-type power which has high temperature conductivity and the outstanding electric insulation with a low cost, and its manufacture technique being acquired.

[0041] Moreover, since the touch area with a thermolysis sink increases while the positioning at the time of joining the above-mentioned sheet made from a resin to the above-mentioned heat sinking plane side front face becomes easy, ***** can be simplified and a manufacture becomes easy, since the sheet made from a resin is joined to all the front faces of a heat sinking plane side front face, it is effective in the semiconductor device for plastic-molded-type power by which fixation in this thermolysis sink was stabilized being obtained.

[0042] Moreover, since it constituted in thermal conductivity higher than the thermal conductivity of the above-mentioned resin-seal section as a sheet made from a resin joined to the heat sinking plane side front face of the resin-seal section of the semiconductor device in the semiconductor device for plastic-molded-type power, even if it fabricates the above-mentioned resin-seal section by the cheap **** resin inferior to thermal conductivity, heat can be radiated efficient in generation of heat of a semiconductor device, and it is effective in the highly reliable semiconductor device for plastic-molded-type power being obtained.

[0043] Moreover, as a sheet made from a resin joined to the heat sinking plane side front face of the

resin-seal section of the semiconductor device in the semiconductor device for plastic-molded-type power, since it is considered as the product made from thermosetting resin of the shape of semi-hardening filled up with the filler of high temperature conductivity before the junction, it has flexibility, junction work becomes very easy on the above-mentioned heat sinking plane side front face about the above-mentioned sheet made from a resin, and it is effective in the highly reliable semiconductor device for plastic-molded-type power being obtained cheaply.

[0044] Moreover, fix a semiconductor device in one principal plane, and the circumference is surrounded while the principal plane of above-mentioned another side in the leadframe with which two or more thermolysis base plates which make the principal plane of another side a heat sinking plane are connected in parallel by the tie rod is exposed. And while a resin seal is carried out and batch formation of two or more resin-seal sections is carried out so that the above-mentioned semiconductor device may be covered. In case of batch formation of two or more of these resin-seal sections, the heat sinking plane side front face which surrounds the circumference of the principal plane of above-mentioned another side in two or more of these resin-seal sections is formed in the principal plane and abbreviation same flat surface of above-mentioned another side. While the batch junction of the strip-of-paper-like sheet made from a resin is carried out on the above-mentioned heat sinking plane side front face including the principal plane of above-mentioned another side in two or more above-mentioned resin-seal sections, the above-mentioned tie rod is cut and two or more above-mentioned resin-seal sections are separately separated from the above-mentioned leadframe. Since it is manufactured according to the process which cuts the excessive fraction of the above-mentioned sheet made from a resin joined to two or more of these resin-seal sections, there is an effect which can be manufactured cheaply by carrying out the batch manufacture of two or more semiconductor devices for plastic-molded-type power.

[Translation done.]